XRF PERFORMANCE CHARACTERISTICS SHEET
Radiation Monitoring Devices; LPA-1

EFFECTIVE DATE: November 27, 1995 **EDITION NO.**: 1

MANUFACTURER AND MODEL:

Make:	*Radiation Monitoring Devices*
Model:	*LPA-1*
Source:	Co^{57}
Note:	This sheet supersedes all previous sheets for the XRF instrument of the make, model, and source shown above.

EVALUATION DATA SOURCE AND DATE:

This sheet is supplemental information to be used in conjunction with Chapter 7 of the HUD *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing* ("HUD Guidelines"). Performance parameters shown on this sheet are calculated from the EPA/HUD evaluation using archived building components. Testing was conducted on approximately 150 test locations. All of the test locations were tested three times, once in March 1995, once in July 1995, and once in September 1995 using three distinct instruments. The instrument that performed testing in March had a new source installed in January 1995 with 12 mCi initial strength. The instrument that performed testing in July had a new source installed in June 1995 with 12 mCi initial strength. The instrument that performed testing in September had a new source installed in February 1995 with 12 mCi initial strength. LPA-1 instruments that were purchased before June 26, 1995 and have not been serviced since June 26, 1995 have a different version of firmware than those instruments sold or serviced after June 26, 1995. Therefore, this sheet distinguishes between instruments sold prior to June 26, 1995 and have not been serviced since June 26, 1995 from those instruments serviced or sold after this date.

FIELD OPERATION GUIDANCE

OPERATING PARAMETERS:

Performance parameters shown in this sheet are applicable only when operating the instrument under the same conditions as the evaluation testing and using the procedures described in Chapter 7 of the HUD Guidelines. Operating parameters include:

- Manufacturer-recommended warm-up and quality control procedures
- Use the Multifamily Decision Flowchart for determining the presence of lead on a component type in multifamily housing
- Quick mode, nominal 20-second standard mode, or nominal 30-second standard mode readings on three locations per component for single-family housing and one location per component for multifamily housing
- The nominal reading time for standard mode readings must be adjusted to account for source decay
- Calibration checks are taken using nominal 30-second standard mode readings and the red (1.02 mg/cm^2) NIST Standard Reference Material (SRM No. 2579) paint film
- Readings for determining the substrate correction values are taken on bare substrate covered with red (1.02 mg/cm^2) NIST SRM paint film

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- Lead-based paint is defined as paint with lead equal to or in excess of 1.0 mg/cm^2.

XRF CALIBRATION CHECK:

Chapter 7 of the HUD Guidelines recommends using a calibration check procedure to determine the operating condition of the XRF instrument. For this instrument, calibration check readings should be taken with nominal 30-second standard mode readings regardless of the date of purchase or servicing. If the observed calibration check average minus 1.02 mg/cm^2 is greater than the positive (plus) calibration check tolerance value, or less than the negative (minus) calibration check tolerance value, then the instructions provided by the manufacturer should be followed in order to bring the instrument back into control before any more XRF testing is done. This calibration check is estimated to produce an incorrect result (that is, a finding that the instrument is out of calibration) very infrequently - once out of every 200 times this procedure is followed.

For those instruments sold prior to June 26, 1995 and have not been serviced since June 26, 1995 use the following calibration check tolerance values:

minus value = -0.3 mg/cm^2
plus value = +0.1 mg/cm^2

For those instruments sold or serviced after June 26, 1995 use the following calibration check tolerance values:

minus value = -0.3 mg/cm^2
plus value = +0.3 mg/cm^2

XRF RESULTS BELOW 4.0 mg/cm^2, SUBSTRATE CORRECTION RECOMMENDED FOR:

For those instruments sold prior to June 26, 1995 and have not been serviced since June 26, 1995:

- Metal and wood using quick mode or either 20-second or 30-second standard mode readings

For those instruments sold or serviced after June 26, 1995:

- Metal using 30-second standard mode readings
- None using quick mode readings

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SUBSTRATE CORRECTION NOT RECOMMENDED FOR:

For those instruments sold prior to June 26, 1995 and have not been serviced since June 26, 1995:

- Brick, Concrete, Drywall, and Plaster using quick mode or either 20-second or 30-second standard mode readings

For those instruments sold or serviced after June 26, 1995:

- Brick, Concrete, Drywall, Plaster, and Wood using 30-second standard mode readings
- Brick, Concrete, Drywall, Metal, Plaster, and Wood using quick mode readings

SUBSTRATE CORRECTION VALUE COMPUTATION:

Chapter 7 of the HUD Guidelines provides guidance on correcting XRF results for substrate bias. Supplemental guidance for using the red (1.02 mg/cm^2) NIST SRM paint film for substrate correction is provided below.

XRF results are corrected for substrate bias by subtracting from each XRF result a correction value determined separately in each house for single-family housing or in each development for multifamily housing, for each substrate. The correction value is an average of XRF readings taken over red NIST SRM (1.02 mg/cm^2) paint films at test locations that had been scraped clean of their paint covering. Compute the correction values as follows:

- Using the same XRF instrument, take three readings on a bare substrate area covered with the red NIST SRM (1.02 mg/cm^2) paint film. Repeat this procedure by taking three more readings on a second bare substrate area of the same substrate.

- Compute the correction value for each substrate type by computing the average of all six readings as shown below.

For each substrate type:

$$\left.\begin{matrix}Correction\\ Value\end{matrix}\right\} = \frac{1^{st} + 2^{nd} + 3^{rd} + 4^{th} + 5^{th} + 6^{th}\ Reading}{6} - 1.02 mg/cm^2$$

- Repeat this procedure for each substrate tested in the house or housing development as needed.

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CLASSIFICATION OF RESULTS USING THRESHOLD VALUES:

XRF results are classified using either the threshold or the inconclusive range. In single-family housing, an XRF result is the average of three readings taken on a testing combination. (A testing combination is a location on a painted surface as defined in Chapter 7 of the HUD Guidelines). In multifamily housing, an XRF result is a single reading taken on a testing combination. For computing the XRF result, use all digits that are reported by the instrument. For the threshold, results are classified as positive if they are greater than or equal to the threshold, and negative if they are less than the threshold. There is no inconclusive classification when using the threshold. For the inconclusive range, results are classified as positive if they are greater than or equal to the upper limit of the inconclusive range, and negative if they are less than or equal to the lower limit of the inconclusive range. Thresholds and inconclusive ranges were determined for comparing results to the 1.0 mg/cm^2 standard. For a listing of laboratories recommended by the EPA National Lead Laboratory Accreditation Program (NLLAP) for the analysis of samples to resolve an inconclusive XRF result or additional confirmational analysis, call the National Lead Information Center Clearinghouse at 1-800-424-LEAD.

For those instruments sold prior to June 26, 1995 and have not been serviced since June 26, 1995:

30-SECOND STANDARD MODE READING DESCRIPTION	**SUBSTRATE**	**THRESHOLD (mg/cm^2)**
Results corrected for substrate bias on metal and wood substrates only	Brick Concrete Drywall Metal Plaster Wood	0.8 0.8 0.7 0.8 0.8 0.9

For those instruments sold prior to June 26, 1995 and have not been serviced since June 26, 1995:

20-SECOND STANDARD MODE READING DESCRIPTION	**SUBSTRATE**	**THRESHOLD (mg/cm^2)**
Results corrected for substrate bias on metal and wood substrates only	Brick Concrete Drywall Metal Plaster Wood	0.7 0.7 0.7 0.9 0.8 0.8

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For those instruments sold prior to June 26, 1995 and have not been serviced since June 26, 1995:

QUICK MODE READING DESCRIPTION	SUBSTRATE	INCONCLUSIVE RANGE (mg/cm^2)
Results corrected for substrate bias on metal and wood substrates only	Brick	0.7 - 0.8
	Concrete	0.7 - 0.8
	Drywall	0.6 - 0.8
	Metal	0.9 - 1.0
	Plaster	0.7 - 0.8
	Wood	0.7 - 0.8

For those instruments sold or serviced after June 26, 1995:

30-SECOND STANDARD MODE READING DESCRIPTION	SUBSTRATE	THRESHOLD (mg/cm^2)
Results corrected for substrate bias on metal substrate only	Brick	1.0
	Concrete	1.0
	Drywall	1.0
	Metal	0.9
	Plaster	1.0
	Wood	1.0

For those instruments sold or serviced after June 26, 1995:

QUICK MODE READING DESCRIPTION	SUBSTRATE	THRESHOLD (mg/cm^2)	INCONCLUSIVE RANGE (mg/cm^2)
Readings not corrected for substrate bias on any substrate	Brick	1.0	None
	Concrete	1.0	None
	Drywall	1.0	None
	Metal	None	0.9 to 1.3
	Plaster	None	0.9 to 1.0
	Wood	1.0	None

INSTRUCTIONS FOR EVALUATING XRF TESTING:

Chapter 7 of the HUD Guidelines recommends several options for evaluating XRF testing. Among those options is the following procedure which may be used after XRF testing has been completed. In single-family housing, an XRF result is the average of three readings taken on a testing combination. (A testing combination is a location on a painted surface as defined in Chapter 7 of the HUD Guidelines). In multifamily housing, an XRF result is a single reading taken on a testing combination. If a multifamily housing development is being retested, randomly select two units from within the development from which the ten testing combinations should be randomly selected.

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Randomly select ten testing combinations for retesting from each house or from the two selected units.

Conduct XRF retesting at the ten testing combinations selected for retesting.

Determine if the XRF testing in the units or house passed or failed the test by applying the steps below.

Compute the Retest Tolerance Limit by the following steps:

Determine XRF results for the original and retest XRF readings. Do not correct the original or retest results for substrate bias. In single-family housing a result is defined as the average of three readings. In multifamily housing, a result is a single reading. Therefore, there will be ten original and ten retest XRF results for each house or for the two selected units.

Compute the square of each of the ten original and ten retest XRF results.

Add these squares of XRF results together. Call this quantity C.

Multiply the number C by 0.0072. Call this quantity D.

Add the number 0.032 to D. Call this quantity E.

Take the square root of E. Call this quantity F.

Multiply F by 1.645. The result is the Retest Tolerance Limit.

Compute the overall average of all ten original XRF results over all ten testing combinations selected for retesting.

Compute the overall average of all ten retest XRF results over all ten testing combinations selected for retesting.

Take the difference of the overall average of the ten original XRF results and the overall average of the ten retest XRF results. If the difference is negative, drop the negative sign.

If the difference of the overall averages is less than the Retest Tolerance Limit, the inspection has passed the retest. If the difference of the overall averages equals or exceeds the Retest Tolerance Limit, this procedure should be repeated with ten new testing combinations. If the difference of the overall averages is equal to or greater than the Retest Tolerance Limit a second time, then the inspection should be considered deficient.

Use of this procedure is estimated to produce a spurious result approximately 1% of the time. That is, results of this procedure will call for further examination when no examination is warranted in approximately 1 out of 100 dwelling units tested.

BIAS AND PRECISION:

Do not use these bias and precision data to correct for substrate bias. These bias and precision data were computed without substrate correction from samples with reported laboratory results less than 4.0 mg/cm^2 lead. The data which were used to determine the bias and precision estimates given in the three tables above have

the following properties. During the March testing, there were 11 test locations with a laboratory reported result equal to or greater than 4.0 mg/cm^2 lead. Of these, one 20-second standard mode reading was less than 1.0 mg/cm^2 and none of the quick mode readings were less than 1.0 mg/cm^2. During the July testing, there were 15 test locations with a laboratory reported result equal to or greater than 4.0 mg/cm^2 lead. Of these, one 30-second standard mode reading was less than 1.0 mg/cm^2 and none of the quick mode readings were less than 1.0 mg/cm^2. During the September testing, there were 15 test locations with a laboratory reported result equal to or greater than 4.0 mg/cm^2 lead. Of these, two 20-second and one 30-second standard mode readings were less than 1.0 mg/cm^2, and one quick mode reading was less than 1.0 mg/cm^2. The two instruments that tested in March and September are representative of instruments sold prior to June 26, 1995 and have not been serviced since June 26, 1995 and the instrument that tested in July is representative of instruments sold or serviced after June 26, 1995. These data are for illustrative purposes only. Actual bias must be determined on the site. Inconclusive ranges provided above already account for bias and precision. Bias and precision ranges are provided to show the variability that was found between machines of the same model. Units are in mg/cm^2.

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For those instruments sold prior to June 26, 1995 and have not been serviced since June 26, 1995:

20-SECOND READING MEASURED AT	SUBSTRATE	BIAS (mg/cm^2)	BIAS RANGE[P] (mg/cm^2)	PRECISION[*] (mg/cm^2)	PRECISION RANGE[P] (mg/cm^2)
0.0 mg/cm^2	Brick	-0.2	(-0.1,-0.2)	0.2	(0.1, 0.2)
	Concrete	-0.2	(-0.1,-0.2)	0.2	(0.1, 0.2)
	Drywall	-0.2	(-0.2,-0.3)	0.2	(0.1, 0.2)
	Metal	-0.4	(-0.4,-0.5)	0.2	(0.1, 0.2)
	Plaster	-0.1	(-0.1,-0.1)	0.2	(0.1, 0.2)
	Wood	-0.2	(-0.1,-0.2)	0.2	(0.1, 0.2)
0.5 mg/cm^2	Brick	-0.2	(-0.2,-0.3)	0.3	(0.2, 0.3)
	Concrete	-0.2	(-0.2,-0.3)	0.3	(0.2, 0.3)
	Drywall	-0.3	(-0.2,-0.3)	0.3	(0.2, 0.3)
	Metal	-0.5	(-0.4,-0.6)	0.3	(0.2, 0.3)
	Plaster	-0.2	(-0.2,-0.2)	0.3	(0.2, 0.3)
	Wood	-0.2	(-0.2,-0.3)	0.3	(0.2, 0.3)
1.0 mg/cm^2	Brick	-0.3	(-0.2,-0.4)	0.3	(0.3, 0.4)
	Concrete	-0.3	(-0.2,-0.4)	0.3	(0.3, 0.4)
	Drywall	-0.3	(-0.3,-0.4)	0.3	(0.3, 0.4)
	Metal	-0.6	(-0.5,-0.6)	0.3	(0.3, 0.4)
	Plaster	-0.2	(-0.2,-0.2)	0.3	(0.3, 0.4)
	Wood	-0.3	(-0.2,-0.4)	0.3	(0.3, 0.4)
2.0 mg/cm^2	Brick	-0.4	(-0.3,-0.5)	0.5	(0.4, 0.5)
	Concrete	-0.4	(-0.3,-0.5)	0.5	(0.4, 0.5)
	Drywall	-0.5	(-0.4,-0.6)	0.5	(0.4, 0.5)
	Metal	-0.7	(-0.6,-0.7)	0.5	(0.4, 0.5)
	Plaster	-0.3	(-0.3,-0.4)	0.5	(0.4, 0.5)
	Wood	-0.4	(-0.3,-0.5)	0.5	(0.4, 0.5)

[P]Ranges are provided to show the variability between machines of the same model.
[*]Precision at 1 standard deviation.

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For those instruments sold prior to June 26, 1995 and have not been serviced since June 26, 1995:

30-SECOND READING MEASURED AT	SUBSTRATE	BIAS (mg/cm^2)	PRECISION* (mg/cm^2)
0.0 mg/cm^2	Brick	-0.1	0.1
	Concrete	-0.1	0.1
	Drywall	-0.2	0.1
	Metal	-0.4	0.1
	Plaster	-0.1	0.1
	Wood	-0.1	0.1
0.5 mg/cm^2	Brick	-0.2	0.2
	Concrete	-0.2	0.2
	Drywall	-0.3	0.2
	Metal	-0.5	0.2
	Plaster	-0.1	0.2
	Wood	-0.2	0.2
1.0 mg/cm^2	Brick	-0.2	0.3
	Concrete	-0.2	0.3
	Drywall	-0.3	0.3
	Metal	-0.6	0.3
	Plaster	-0.2	0.3
	Wood	-0.2	0.3
2.0 mg/cm^2	Brick	-0.4	0.4
	Concrete	-0.4	0.4
	Drywall	-0.5	0.4
	Metal	-0.7	0.4
	Plaster	-0.3	0.4
	Wood	-0.4	0.4

*Precision at 1 standard deviation.

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For those instruments sold prior to June 26, 1995 and have not been serviced since June 26, 1995:

QUICK MODE MEASURED AT	SUBSTRATE	BIAS (mg/cm^2)	BIAS RANGE[P] (mg/cm^2)	PRECISION[*] (mg/cm^2)	PRECISION RANGE[P] (mg/cm^2)
0.0 mg/cm^2	Brick	-0.2	(-0.2,-0.3)	0.3	(0.3, 0.3)
	Concrete	-0.2	(-0.2,-0.3)	0.3	(0.3, 0.3)
	Drywall	-0.3	(-0.2,-0.3)	0.3	(0.3, 0.3)
	Metal	-0.6	(-0.6,-0.7)	0.3	(0.3, 0.3)
	Plaster	-0.2	(-0.2,-0.2)	0.3	(0.3, 0.3)
	Wood	-0.2	(-0.2,-0.3)	0.3	(0.3, 0.3)
0.5 mg/cm^2	Brick	-0.3	(-0.2,-0.3)	0.4	(0.3, 0.4)
	Concrete	-0.3	(-0.2,-0.3)	0.4	(0.3, 0.4)
	Drywall	-0.3	(-0.3,-0.4)	0.4	(0.3, 0.4)
	Metal	-0.7	(-0.6,-0.8)	0.4	(0.3, 0.4)
	Plaster	-0.2	(-0.2,-0.2)	0.4	(0.3, 0.4)
	Wood	-0.3	(-0.2,-0.3)	0.4	(0.3, 0.4)
1.0 mg/cm^2	Brick	-0.3	(-0.3,-0.4)	0.4	(0.4, 0.5)
	Concrete	-0.3	(-0.3,-0.4)	0.4	(0.4, 0.5)
	Drywall	-0.4	(-0.3,-0.4)	0.4	(0.4, 0.5)
	Metal	-0.7	(-0.7,-0.8)	0.4	(0.4, 0.5)
	Plaster	-0.3	(-0.3,-0.3)	0.4	(0.4, 0.5)
	Wood	-0.3	(-0.3,-0.4)	0.4	(0.4, 0.5)
2.0 mg/cm^2	Brick	-0.4	(-0.4,-0.5)	0.5	(0.4, 0.6)
	Concrete	-0.4	(-0.4,-0.5)	0.5	(0.4, 0.6)
	Drywall	-0.5	(-0.4,-0.6)	0.5	(0.4, 0.6)
	Metal	-0.8	(-0.7,-1.0)	0.5	(0.4, 0.6)
	Plaster	-0.4	(-0.4,-0.4)	0.5	(0.4, 0.6)
	Wood	-0.4	(-0.4,-0.5)	0.5	(0.4, 0.6)

[P]Ranges are provided to show the variability between machines of the same model.
[*]Precision at 1 standard deviation.

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For those instruments sold or serviced after June 26, 1995:

30-SECOND STANDARD MODE READING MEASURED AT	SUBSTRATE	BIAS (mg/cm^2)	PRECISION* (mg/cm^2)
0.0 mg/cm^2	Brick	0.0	0.1
	Concrete	0.0	0.1
	Drywall	0.1	0.1
	Metal	0.3	0.1
	Plaster	0.1	0.1
	Wood	0.0	0.1
0.5 mg/cm^2	Brick	0.0	0.2
	Concrete	0.0	0.2
	Drywall	0.0	0.2
	Metal	0.2	0.2
	Plaster	0.0	0.2
	Wood	0.0	0.2
1.0 mg/cm^2	Brick	0.0	0.3
	Concrete	0.0	0.3
	Drywall	0.0	0.3
	Metal	0.2	0.3
	Plaster	0.0	0.3
	Wood	0.0	0.3
2.0 mg/cm^2	Brick	-0.1	0.4
	Concrete	-0.1	0.4
	Drywall	-0.1	0.4
	Metal	0.1	0.4
	Plaster	-0.1	0.4
	Wood	-0.1	0.4

*Precision at 1 standard deviation.

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For those instruments sold or serviced after June 26, 1995:

QUICK MODE READING MEASURED AT	SUBSTRATE	BIAS (mg/cm^2)	PRECISION* (mg/cm^2)
0.0 mg/cm^2	Brick	0.0	0.2
	Concrete	0.0	0.2
	Drywall	0.0	0.2
	Metal	0.2	0.2
	Plaster	0.0	0.2
	Wood	0.0	0.2
0.5 mg/cm^2	Brick	0.0	0.3
	Concrete	0.0	0.3
	Drywall	0.0	0.3
	Metal	0.2	0.3
	Plaster	0.0	0.3
	Wood	0.0	0.3
1.0 mg/cm^2	Brick	0.0	0.4
	Concrete	0.0	0.4
	Drywall	0.0	0.4
	Metal	0.1	0.4
	Plaster	-0.1	0.4
	Wood	0.0	0.4
2.0 mg/cm^2	Brick	-0.1	0.5
	Concrete	-0.1	0.5
	Drywall	-0.1	0.5
	Metal	0.1	0.5
	Plaster	-0.1	0.5
	Wood	-0.1	0.5

*Precision at 1 standard deviation.

A document titled *Methodology for XRF Performance Characteristic Sheets* provides an explanation of the statistical methodology used to construct the data in the sheets and provides empirical results from using the recommended inconclusive ranges or thresholds for specific XRF instruments. For a copy of this document call the National Lead Information Center Clearinghouse at 1-800-424-LEAD.

This XRF Performance Characteristics Sheet is a joint product of the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Housing and Urban Development (HUD). The issuance of this sheet does not constitute rulemaking. The information provided here is intended solely as guidance to be used in conjunction with Chapter 7 of the *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing*. EPA and HUD reserve the right to revise this guidance. Please address questions and comments on this sheet to: Director, Office of Lead-Based Paint Abatement and Poisoning Prevention, U.S. Department of Housing and Urban Development, Room B-133, 451 Seventh St, S.W., Washington, DC 20410.